SE COMP (2019 Course)

DIGITAL ELECTRONICS AND LOGIC DESIGN

MINIMIZATION TECHNIQUE

TOPIC: IC,LOGICAL FUNCTION

Objectives

- To study pin configuration of logic gates IC
- To study the representation of logical function/Boolean function

Unit I	Minimization Technique	(06 Hours)
Logic Design Minimization Technique -: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.		
#Exemplar/Case Studies	Digital locks using logic gates	

INTEGRATED CIRCUIT

- An integrated circuit or monolithic integrated circuit (also referred to as an IC, a chip, or a microchip) is a set of electronic circuits on one small plate ("chip") of semiconductor material, normally silicon.
- ICs can be made very compact, having up to several billion transistors and other electronic components in an area the size of a human fingernail.

INTEGRATED CIRCUIT

- LEVEL OF INTEGRATION

1.SSI : Small Scale Integration

-It has less than 100 components(about 10gates)

2.MSI: Medium Scale Integration

-It contains less than 500 components or have more than 10 but less than 100 gates.

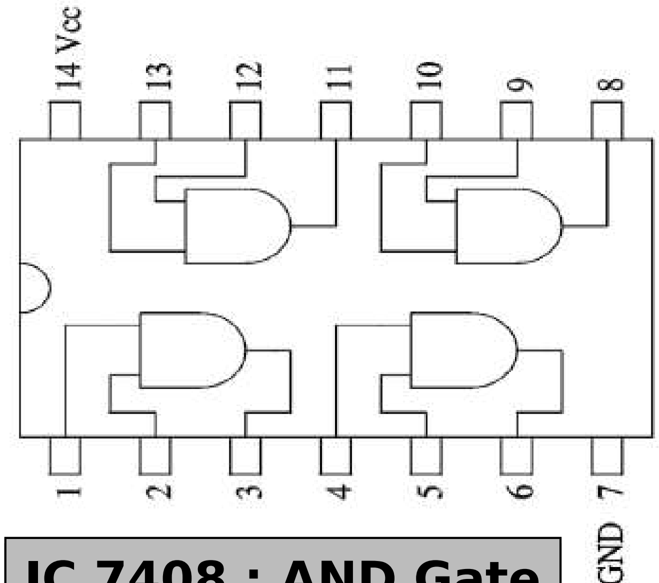
3.LSI: Large scale integration

-Number of components is between 500 and 300000 or have more than 100gates.

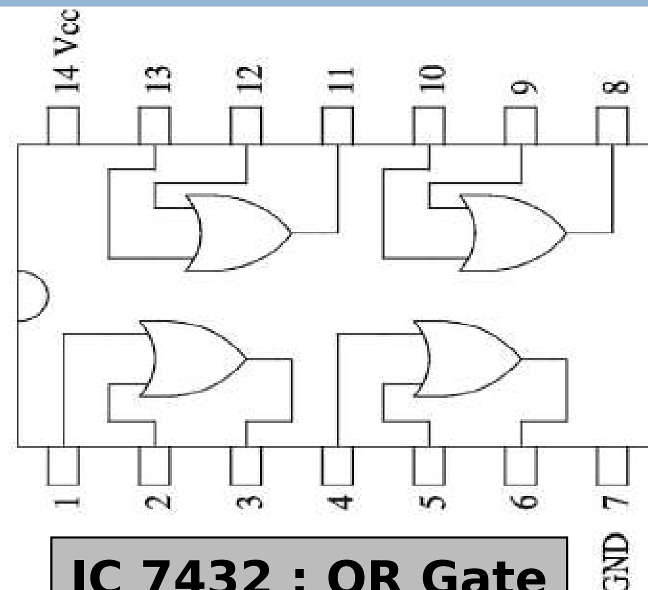
4.VLSI:very large scale integration.

-A process of creating an integrated circuit (IC) by combining thousands of transistors into a single chip. .

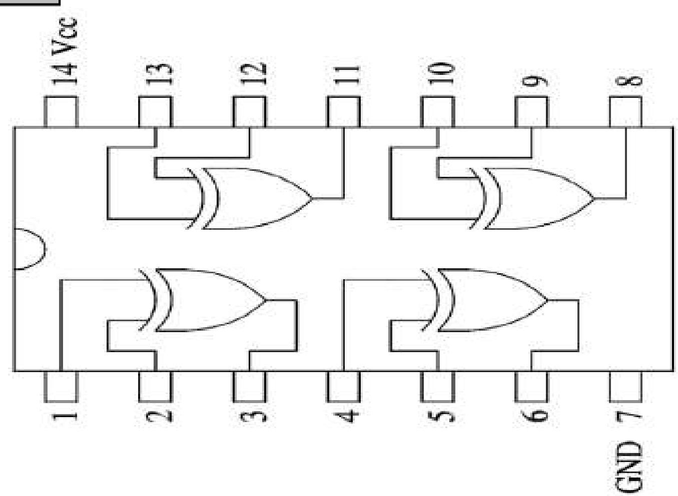
IC:



IC 7408 : AND Gate

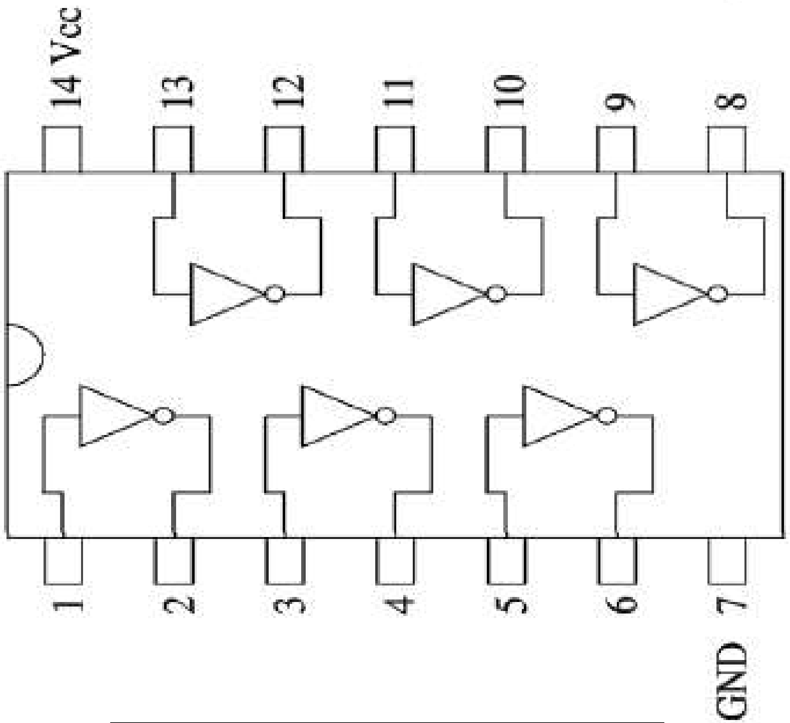


IC 7432 : OR Gate

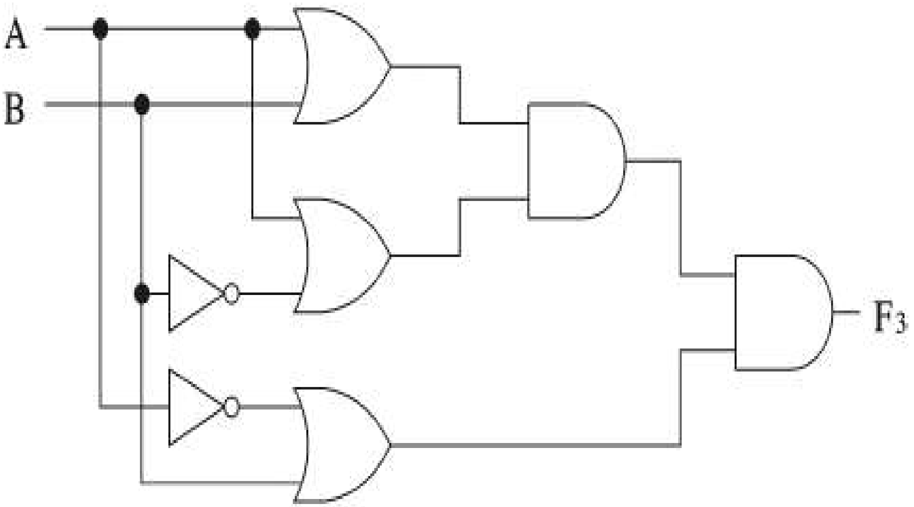


C 7486 : Ex-OR Gate

IC:



IC 7404 : NOT Gate



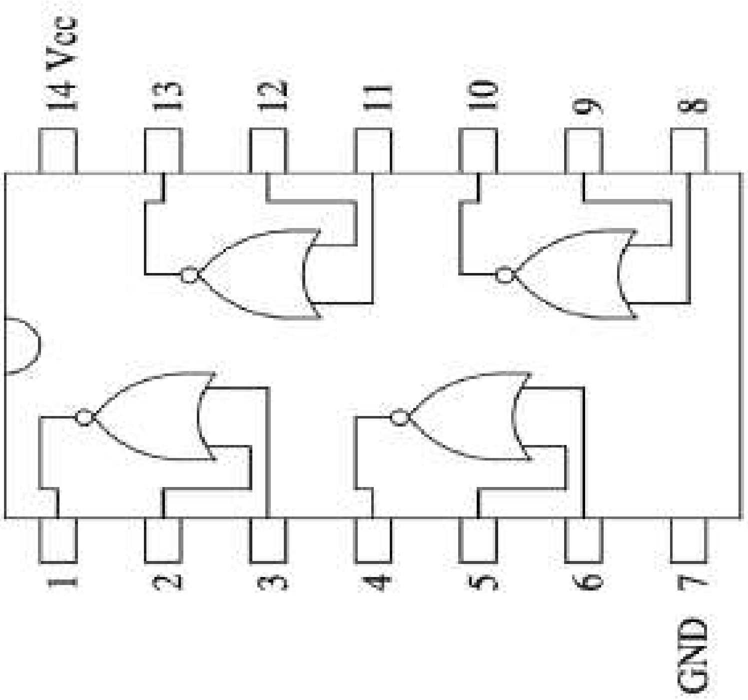
NOT Gate(7404)= 1

AND Gate(7408)= 1

OR Gate(7432)= 1

IC:

IC 7400 : NAND Gate = Pin configuration is same as AND gate



IC 7402 : NOR Gate

Logic Functions

- Logical functions can be expressed in several ways:
  - Truth table
  - Logical expressions
  - Graphical form

Example:

- Majority function
  - Output is 1 whenever majority of inputs is 1
  - We use 3-input majority function

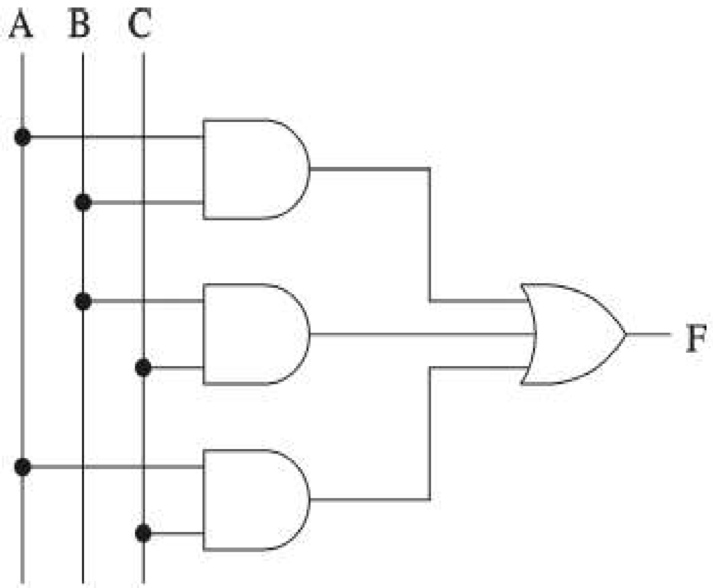
Logic Functions (cont.)

3-input majority function

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

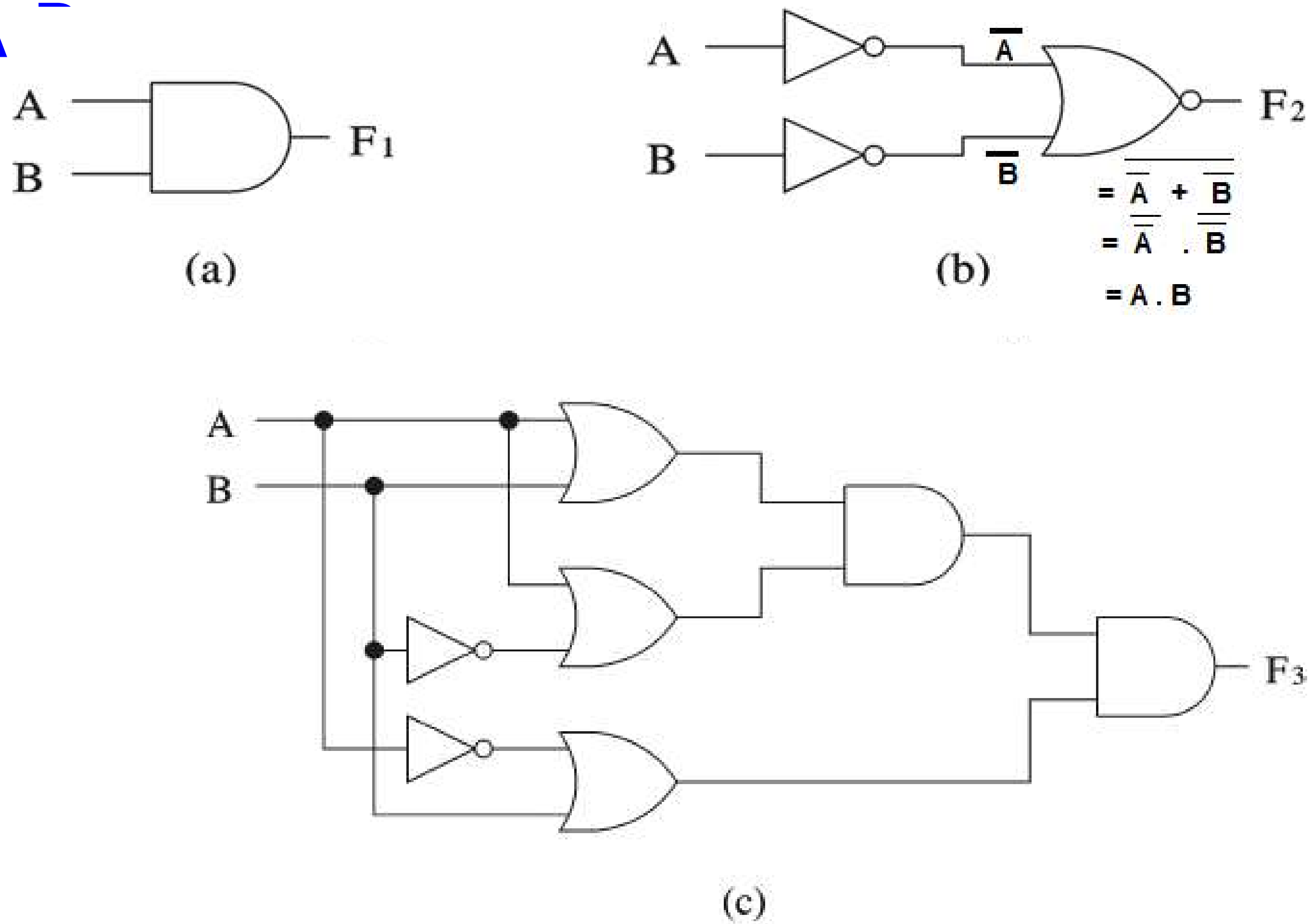
- Logical expression form

  $F = A\,B + B\,C + A\,C$



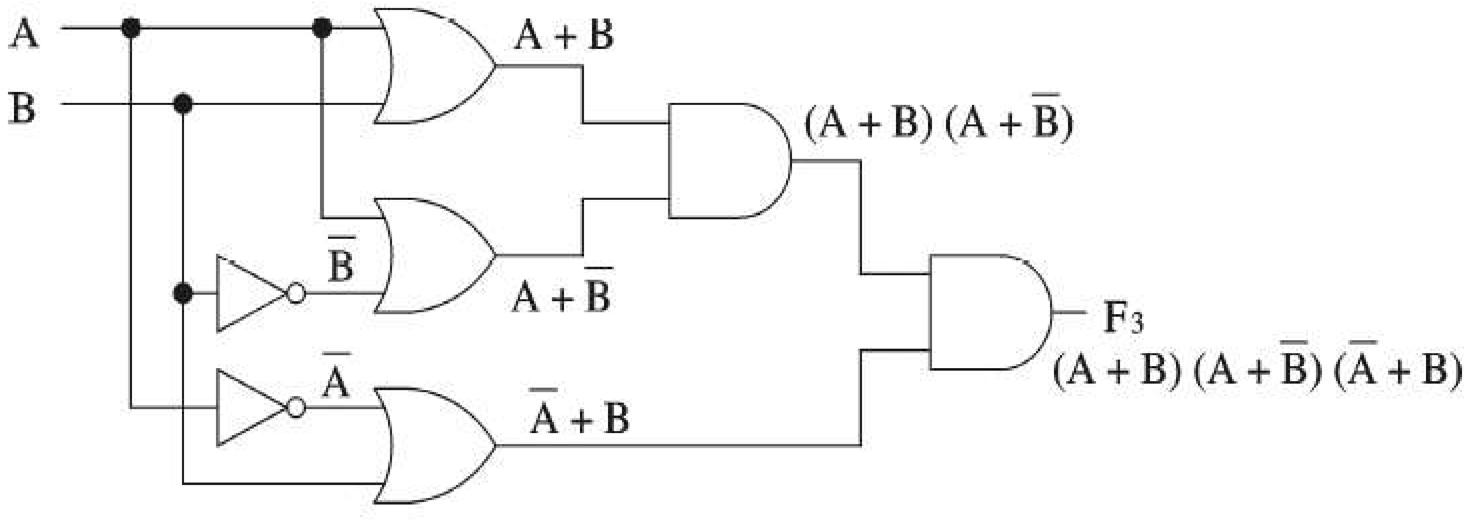
Logical Equivalence

- All three circuits implement function F = A



Logical Equivalence (Cont.)

- Derivation of logical expression from a circuit
  - Trace from the input to output
    - Write down intermediate logical expressions



Logical Equivalence (Cont.)

- Proving logical equivalence: Truth table method

A	B	F1 = A B	F3 = (A + B) (A + $\overline{B}$) ($\overline{A}$ + B)
0	0	0	0
0	1	0	0
1	0	0	0
1	1	1	1

How to minimize a Boolean/Logical function?

There are four ways to solve any function.

1. Boolean Algebra.
2. K-Map.
3. Quine-McCluskey Technique.
4. Variable Mapping Function.

Basic Theorems of Boolean Algebra

1. Identity Elements

$1 . A = A$

$0 + A = A$

2. Inverse Elements

$A . A = 0$

$A + A = 1$

3. Idempotent Laws

$A + A = A$

$A . A = A$

4. Boundess Laws

$A + 1 = 1$

$A . 0 = 0$

5. Distributive Laws

$A . (B + C) = A.B + A.C$

$A + (B . C) = (A+B) . (A+C)$

6. Order Exchange Laws

$A . B = B . A$

$A + B = B + A$

7. Absorption Laws

$A + (A . B) = A$

$A . (A + B) = A$

8. Associative Laws

$A + (B + C) = (A + B) + C$

$A . (B . C) = (A . B) . C$

9. Elimination Laws

$A + (\bar{A} . B) = A + B$

$A . (\bar{A} + B) = A . B$

10. De Morgan Theorem

$\overline{(A + B)} = \bar{A} . \bar{B}$

$\overline{(A . B)} = \bar{A} + \bar{B}$